Table 6. Germination of foliage plant seeds in potting medium treated with various algicides and fungicides (Expt. 8).

Treatment (rate a.i./liter)	*Asparagus*[z] sp.	*Brassaia*[y] *actinophylla*	*Philodendron*[y] *selloum*	*Schefflera*[y] *arboricola*
Control	7.8a[x]	12.4a	2.8ab	4.4a
QA #2 (0.3 ml)	6.8a	12.8a	6.4abc	3.2a
Dodine (2.0 ml)	8.2a	12.6a	1.8a	1.6a
Mancozeb 2 (2.4 g)	7.4a	12.2a	7.8c	2.0a
Zineb 2 (2.2 g)	9.6a	15.4a	3.8abc	2.6a
QA #1 (0.2 ml)	13.2a	13.2a	1.8a	2.2a
Sodium hypochlorite (5.2 ml)	7.8a	11.4a	7.2bc	3.2a

[z]Twenty seeds per each of 5 pots were rated for germination 39 days after planting. Number given is the mean for 5 pots.
[y]Twenty-five seeds per each of 5 pots were rated for germination 39 days after planting. Number given is the mean for 5 pots.
[x]Mean separation in columns by Duncan's new multiple range test, 5% level.

to plant foliage, but do not provide algae control for as long a period as the fungicides. Our phytotoxicity trials with foliage plants and seeds do not establish the long-term safety of the products should they be used routinely to control algae on the plants themselves. However, similar use of the carbamate products for disease control is safe and many foliage plants are found on their labels. Since each producer has different conditions and requirements for algae control, each must determine the best product for their nursery.

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EFFECT OF SIMULATED SHIPPING TEMPERATURE AND DURATION ON PREFINISHED FLOWERING HIBISCUS

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Abstract. **Budded hibiscus, (Hibiscus Rosa-sinensis L.), 'Seniorita' and 'Red American Beauty' were paper sleeved, boxed, and placed into simulated shipping temperatures of 40, 60, or 80°F for 2, 4, or 7 days then placed in the greenhouse until flowering. Plants held at 40 and 80°F abscissed a large number of buds when held for 4 days or longer. Bud abscission occurred for all buds, regardless of size at time of treatment initiation. Severe bud abscission was not related to water stress during shipping since water potential of all plants was similar at time of unboxing.**

The importance of flowering potted plants is increasing in Florida and the United States. Production of poinsettias, chrysanthemums, gloxinia, bedding plants, and numerous other flowering plants has increased in Florida in recent years (9). There also has been increased consumer interest and rapid production expansion in crops such as gerberas, hibiscus, and exacum. Many of these plants are sold outside Florida and may require 2-7 days shipping to reach the consumer.

Shipping temperature and duration are important factors in maintaining the post-production quality of flowering and foliage plants (2, 4, 5, 6, 7, 8). Shipping requirements differ with each plant species. Increased shipping time (10-15 days) resulted in greater leaf drop in *Ficus benjamina* L. plants at temperatures of 60-65°F (6). But, shipping studies with 4 foliage plants showed a wide range of acceptable temperatures and durations with plants being stored for 21 days without a significant loss of quality (5). 'Glory' poinsettia exhibited best quality when shipped at 55°F while less epinasty and highest quality plants were observed on 'Annette Hegg Dark Red' and 'Annette Hegg Supreme' at 60°F (7, 8). Shipping temperatures of 60°F caused excessive leaf loss in 'Amy' (3). Shipping at low temperatures (40°F) has been best with chrysanthemums (4), geraniums (2), and azaleas (Nell and Hackman, unpublished data).

Budded hibiscus are being produced in Florida as prefinished flowering potted plants and numerous growers have reported severe bud and leaf abscission following shipping to commercial forcers. These studies were established to identify the role of shipping on bud abscission.

Materials and Methods

Budded hibiscus, 'Red American Beauty' and 'Seniorita', were obtained from a commercial source and placed in a double polyethylene covered greenhouse in Gainesville, FL for 1-5 days prior to initiation of treatments. In all experiments, plants were placed into paper sleeves and wax-lined cardboard boxes before placement in environmentally controlled chambers. At the termination of treatments, plants were unboxed, unsleeved, watered, and placed at 70-75°F and 70 ft-c of light for approximately 12 hr before being moved to the greenhouse. The greenhouse provided a maximum light intensity of 6000-7000 ft-c. Minimum night temperatures were 65-68°F and maximum day temperatures were 90-95°F. Plants were maintained well watered without fertilizer prior to and following treatments.

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Expt. 1. 'Red American Beauty' and 'Seniorita' plants were placed into chambers for 2, 4, or 7 days at 40, 60, or 80°F. The number of buds present was determined after 5 days in the greenhouse. A randomized complete block design was used with 4 plants per experimental unit and 3 blocks.

Expt. 2. The number of buds measuring either less than 0.5 inches or greater than 0.5 inches on 1 shoot were counted and the shoot was tagged before treatments were initiated. Plants were placed into chambers for 2, 4, or 7 days at 80°F. Remaining buds on tagged shoots were determined again after 5 days in the greenhouse. A randomized complete block design was used with 4 plants per experimental unit and 3 blocks.

Expt. 3. 'Red American Beauty' plants were watered and the container was either enclosed in a plastic bag or remained unbagged. Plants were sleeved, weighed, boxed, and placed into chambers at 80°F. Plants were removed from boxes after 1 day and reweighed. Additional unbagged plants were placed in 40 or 80°F chambers for 7 days. Shoot water potential was determined upon removal from the chambers. Six plants per treatment were used for evapotranspiration and water potential measurements.

Results and Discussion

Expt. 1. 'Red American Beauty' and 'Seniorita' responded similarly to shipping temperatures and duration. When shipping durations were extended past 4 days plants had the greatest number of buds remaining at the 60°F shipping temperature (Table 1). 'Red American Beauty' plants shipped for 7 days at 40 or 80°F had 6 and 5 buds remaining, respectively, following treatment compared to 21 buds when plants were shipped at 60°F. Shipping duration was most detrimental on both cultivars at the low and high temperatures and long duration.

Table 1. Effect of simulated shipping temperature and duration on bud abscission 5 days after plants were returned to the greenhouse. Expt. 1.

Temperature (°F)	Duration (days)	Number of flower buds per plant remaining following treatment	
		Senorita	Red American Beauty
40	2	39	33
40	4	26	24
40	7	7	6
60	2	36	24
60	4	34	30
60	7	28	21
80	2	33	37
80	4	25	24
80	7	8	5
Temperature		0.01	NS
Shipping duration		0.01	0.01
Shipping x Temperature		0.01	0.01

Foliage began to yellow at all temperatures following 7 days shipping. This problem may contribute to poor quality plants in extended shipping conditions regardless of shipping temperature and bud abscission.

Expt. 2. Most buds abscissed on plants held at 80°F, regardless of duration (Table 2). Plants had 2 to 4 times more buds greater than 0.5 inches long compared to buds less than 0.5 inches prior to simulated shipping. However, simulated shipping conditions resulted in abscission, regardless of bud size at time of treatment. Plants held for 4 days or less had most buds intact upon removal from the boxes but abscission progressed rapidly within 3 days following treatment. Buds turned yellow followed by yellowing of the pedicel before separation occurred. The abscission zone developed about 1 cm below the epicalyx between the pedicel and the peduncle proper (1). The abscission process was completed and separation occurred on most plants

Table 2. Effect of 80°F simulated shipping temperature on flower bud abscission of hibiscus 'Red American Beauty'. Expt. 2.

Duration (days)	Number of flower buds prior to treatments		Number of flower buds following treatments[z]	
	<0.5 inches	>0.5 inches	<0.5 inches	>0.5 inches
2	7	16	1	1
4	6	19	5	3
7	5	20	0	0

[z]Bud number determined 5 days after plants were returned to the greenhouse.

Table 3. Evapotranspiration and transpiration of hibiscus 'Red American Beauty after 24 hr of shipping at 80°F. Expt. 3.

	Weight loss (g)
Transpiration	33
Evapotranspiration	66

in the 7 days simulated shipping treatment by the time plants were unboxed.

Expt. 3. Plants held at 80°F lost an equal amount of water from the medium as from the plant (Table 3). However, the evapotranspiration rate was considerably lower than plants maintained under greenhouse conditions. The rate of evapotranspiration at 40 and 80°F was not sufficient during 7 days of shipping to alter water potential as all plants had a shoot water potential of −2.7 to −2.9 bars upon removal from the shipping boxes.

The present results indicate the importance of careful monitoring of temperature during packing and shipping of budded hibiscus. Shipping temperatures of 60°F for less than 4 days appears to be most conducive to maintenance of high quality prefinished flowering hibiscus.

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